

Overview of Biomass RD&D Activities in California

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European Biomass Energy Association

15th European Biomass Conference and Exhibition

Hall 3, ICC Berlin

International Congress Center, Berlin, Germany





Outline

- Introduction - California Energy Commission
- California's Energy Picture
- Biomass Policy Drivers
- Status of Bioenergy in California
- Public Interest Energy Research Program
- PIER Biomass Research Activities
- Concluding Remarks





The **California Energy Commission** is the state's primary energy policy and planning agency. Created by the Legislature in 1974 and located in Sacramento, California.

The Commission has five major responsibilities:

- Forecasting future energy needs and keeping historical energy data
- Licensing thermal power plants 50 megawatts or larger
- Promoting energy efficiency through appliance and building standards
- Developing energy technologies and supporting renewable energy
- Planning for and directing state response to energy emergency

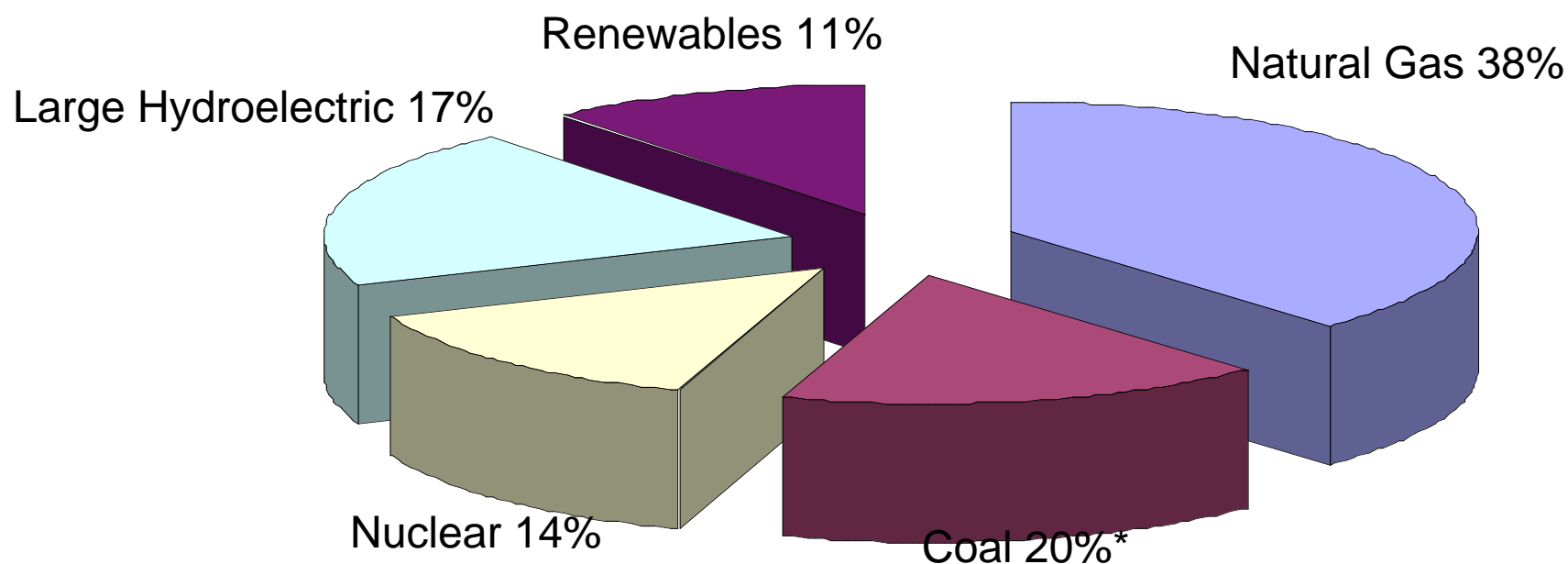




- With the signing of the Electric Industry Deregulation Law in 1998 ([Assembly Bill 1890](#)), the Commission's role includes:
 - overseeing funding programs that support public interest energy research (PIER); advance energy science and technology through research, development and demonstration; and
 - provide market support to existing, new and emerging renewable technologies.
- With energy challenges facing the state, the Commission and its dedicated staff --stand ready to turn challenges into opportunities and help Californians continue to have energy choices that are affordable, reliable, diverse, safe and environmentally acceptable.



California Electricity Production 2005 (Total=288,245 GWh)



*Intermountain and Mohave coal plants are considered in-state, since they are in California control areas.



California Biomass Energy Policy Drivers

- Governor's Executive Order S-06-06 –biomass & biofuels
- Bioenergy Action Plan (July 13, 2006, Governor announces action plan to reduce petroleum dependence and improve air quality)
- AB 32 – Global Warming Solutions Act
- Governor's GHG Reduction Targets (Executive Order S-3-05)
- Renewables Portfolio Standard, 20% by 2010 and 33% by 2020
- Integrated Energy Policy Reports (IEPR) (2003, 2004 update, 2005)
- Energy Action Plan (EAP) I and II (published 2003 and 2005 respectively)
- Governor's 2003 / 2004 IEPR response and Ten Point Plan
- US 2005 Energy Policy Act
- Western Governor's Association (Charter, 2005 Annual Report, 2003 Policy Roadmap)





Executive Order S-06-06






- By 2010, producing 20 percent of its biofuels within California, increasing to 40 percent by 2020 and 75 percent by 2050, and
- By 2010, producing 20 percent of the renewable electricity generated from biomass resources within the State and maintaining this level through 2020.

-The Governor directed several state agencies to take major steps toward the widespread use of biomass to produce clean, renewable transportation fuels or electricity.

--Reinvigorated the Bioenergy Interagency Working Group through the help of the California Biomass Collaborative



Bioenergy Action Plan Objectives

-  Establish California as a market leader in technology innovation, sustainable biomass development, and market development for bio-based products.
-  Coordinate research, development, demonstration, and commercialization efforts across federal and state agencies. ----Develop biomass roadmap.
-  Align existing regulatory requirements to encourage production and use of California's biomass resources.
-  Facilitate market entry for new applications of bioenergy including electricity, biogas, and biofuels.
-  Maximize the contributions of bioenergy toward achieving the state's petroleum reduction, climate change, renewable energy, and environmental goals.



Biomass power and capacity needed to meet 20% share of accelerated RPS

	RPS (%)	Renewable power under RPS (GWh/y)	20% Biomass goal (GWh/y)	Biomass capacity required above current 2005 (MW- 0.85 cap. Factor)
2010	20	58,575	11,700	575
2020	33	109,400	21,875	1,975
2050	33	136,500	27,300	2,670



Biofuel Goals

Executive Order S-06-06 and Bioenergy Action Plan articulated goals for in-state biofuel production (i.e., by 2010 20% of state's biofuel should be produced in-state, increasing to 40% by 2020, and 75% by 2050).

Instate biofuel goals (million gallons per year)

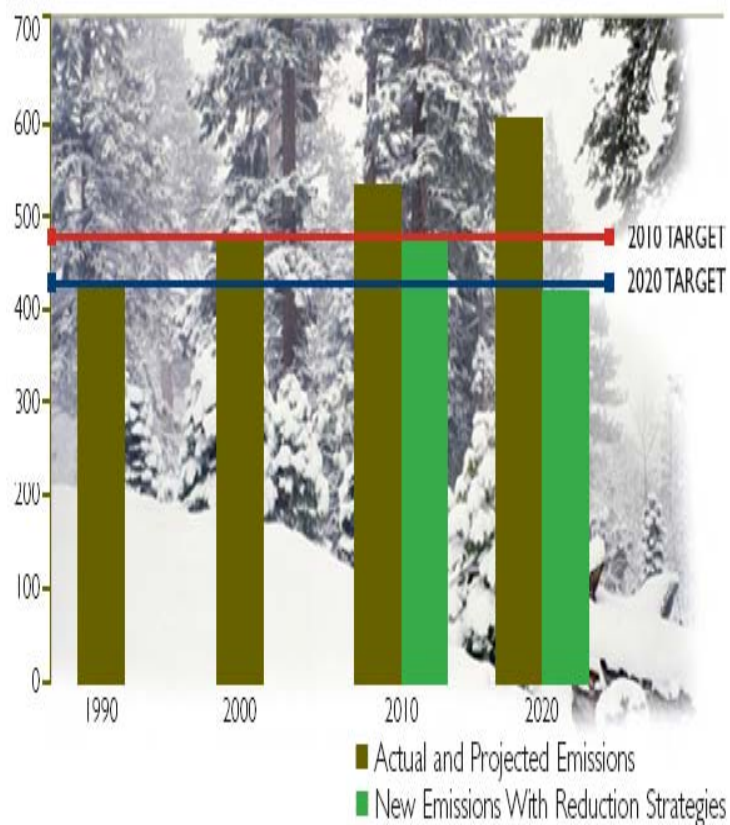
Year	Ethanol				Biodiesel			
	E5.7	E10	E20	B2	B5	B10	B20	
2010	183	325	675	13	32	65	130	
2020	390	700	1430	35	85	170	345	
2050	900	1,570	3,250	150	375	750	1,490	



Source: Williams, R. B. 2006. California Biomass Collaborative



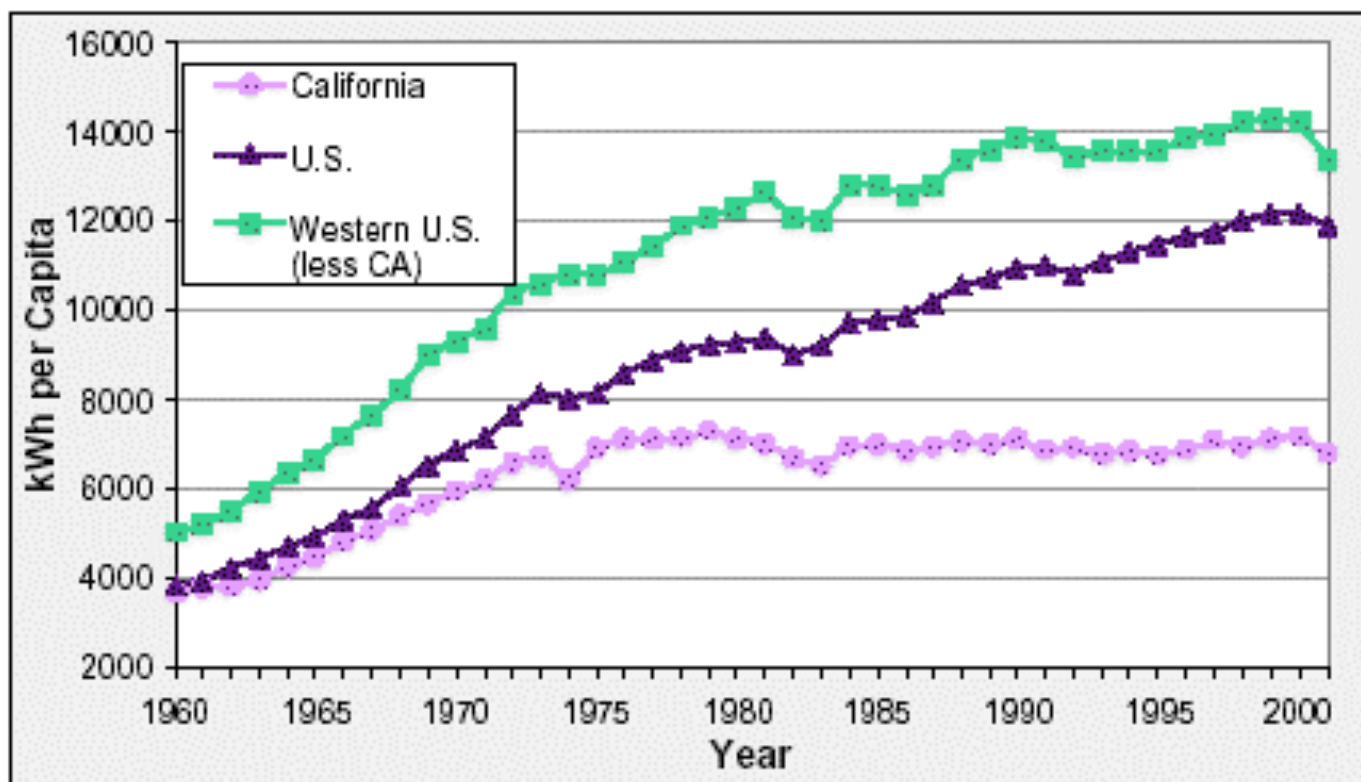
2006 Legislation Provides New Policy Goals and Urgency for California Energy Sectors



- **AB 32 – Global Warming Solutions Act of 2006; aggressive goals for 2020**
- SB 1368 – GHG Emissions standards for Municipal Utilities
- AB 2021 – Energy Efficiency for Municipal Utilities
- AB 2160 – Green Building Acquisition Financing for State Facilities
- **SB107 – Accelerated RPS Goals**
- SB1 – PV and Renewables Goals for New and Existing Residential and Commercial Structures
- AB 2778 – Self-Generation Incentive Program for Fuel Cells and Wind
- SB 1250 – PIER and Renewables Incentive Programs Reauthorized



Total Electricity Use Per Capita 1960- 2001



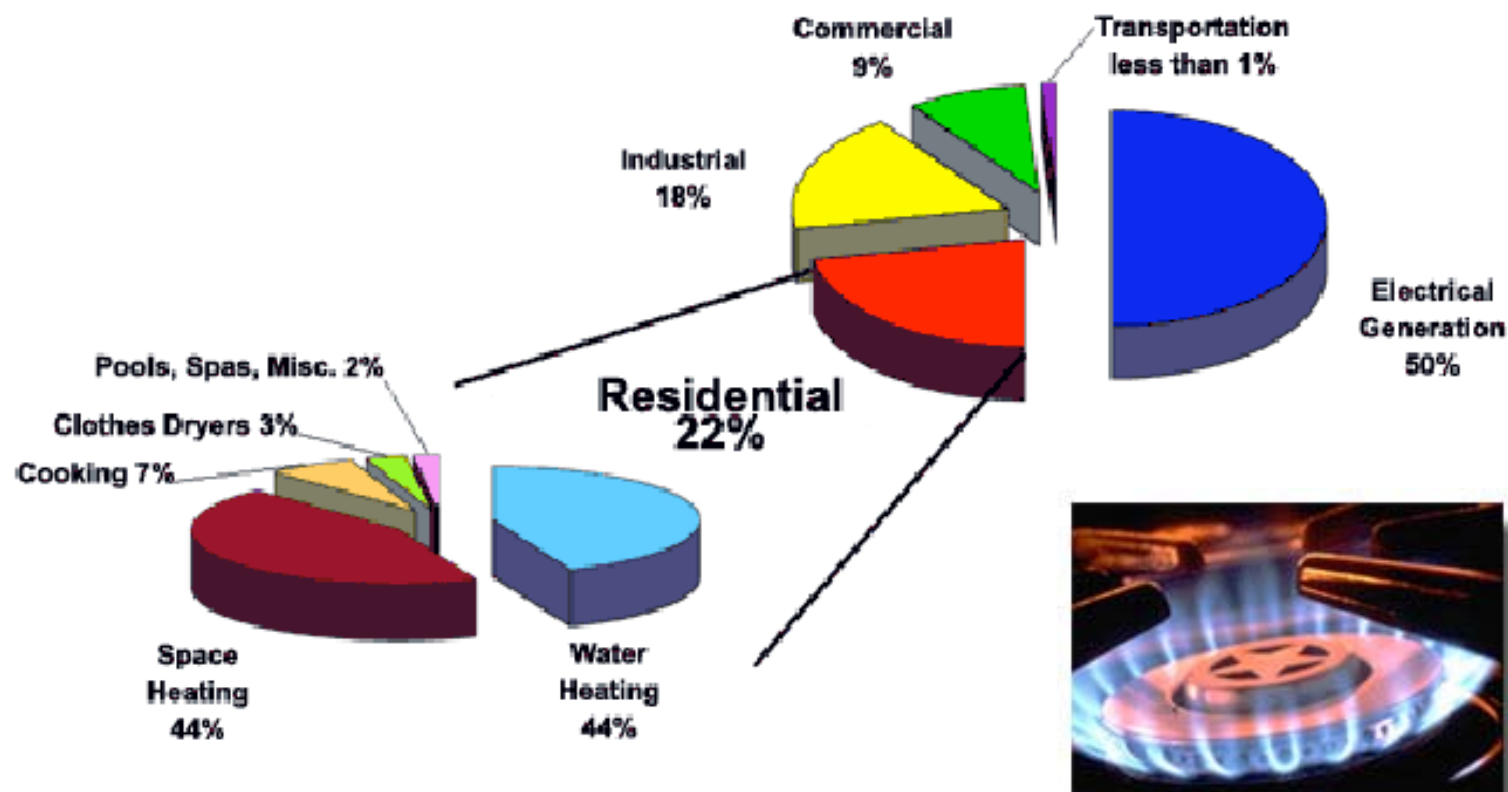
Californians use almost 50 percent less electricity than the U.S. average
Source: Energy Information Agency and California Energy Commission

*Efficiency has reduced the growth of CA electricity use
but new resources are still needed.*



2004 Natural Gas Use in California

2004 Natural gas consumption ~ 228 Bcf

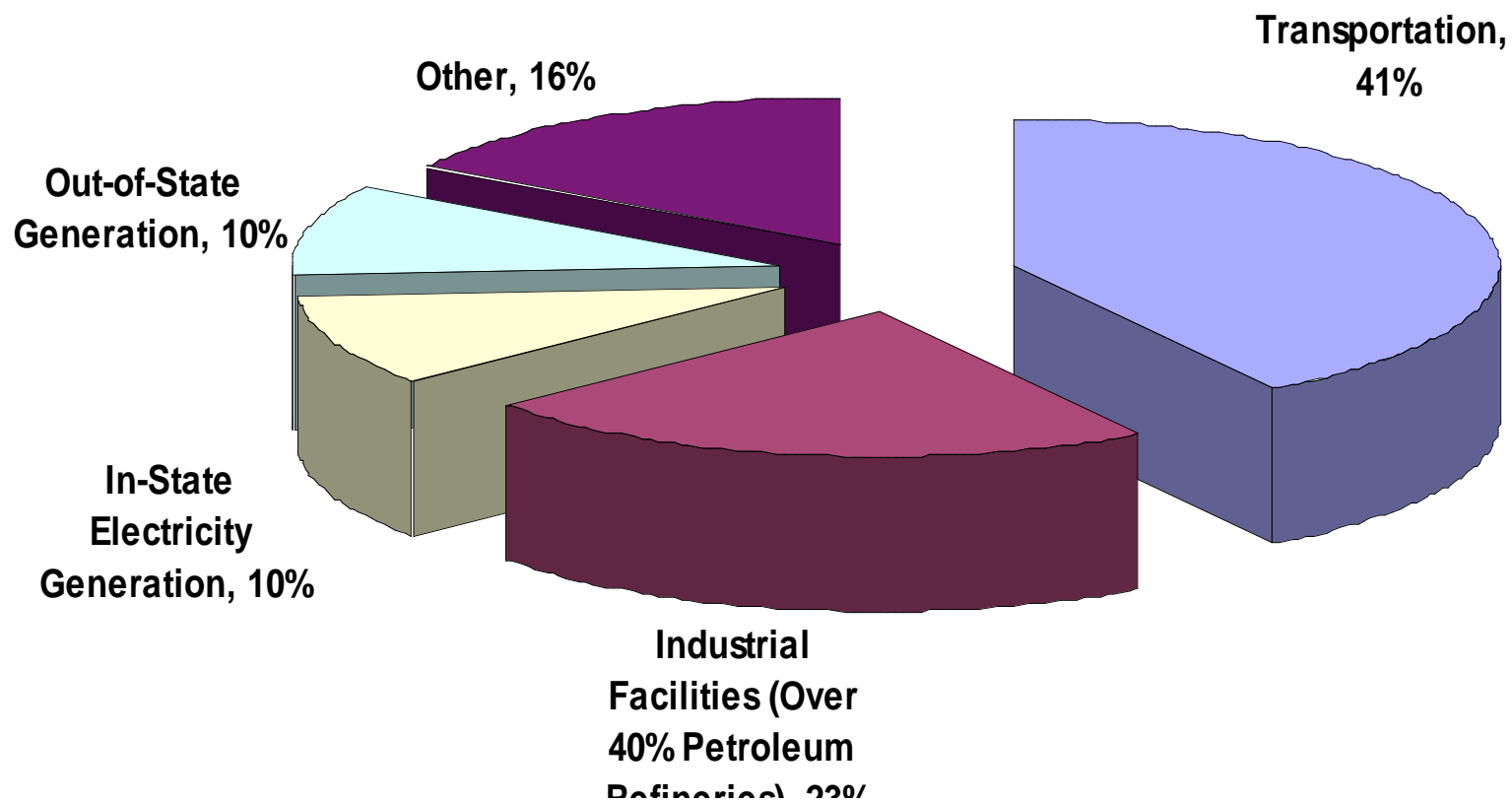


Biogas can displace natural gas broadly in direct uses.



California Greenhouse Gas Emissions

The total GHG emissions for 2004 are ~500 million tons of CO₂ equivalent



California Sources of non-CO₂ GHG's

Table 3-5. Sources of non-CO₂ GHGs in California. Inventory units are MMT CO₂ eq.

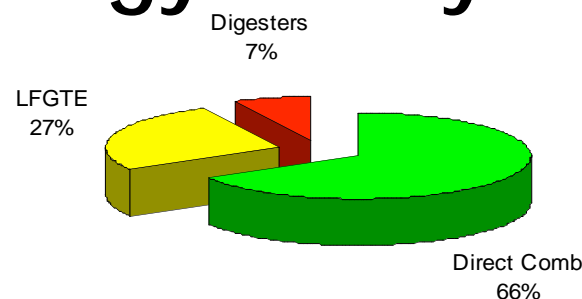
GHG	Activity	Calif. inventory and percentage	Calif. Rank	U.S. inventory and rank
N ₂ O	Agricultural Soils	14.7 (23%)	1	298 (1)
CH ₄	Landfills	13.2 (20%)	2	204 (2)
CH ₄	Enteric Fermentation	7.1 (11%)	3	117 (4)
High-GWP gases	Ozone Depleting Substance Substitutes	7.0 (11%)	4	51 (5)
N ₂ O	Mobile Source Combustion	6.2 (10%)	5	59 (7)
CH ₄	Manure Management	5.2 (8%)	6	39 (8)
CH ₄	Natural Gas System	2.9 (5%)	7	120 (3)
High-GWP gases	Electric Utilities	1.9 (3%)	8	16 (15)
CH ₄	Wastewater	1.4 (2%)	9	29 (10)
N ₂ O	Human Sewage	1.1 (2%)	10	9 (16)
High-GWP gases	Semiconductors	0.8 (1%)	11	7 (18)
SUBTOTAL		61.5 (95.5%)		
Other		2.9 (4.5%)		
TOTAL		64.4 (100%)		

Ref: CEC # 500-2005-097



California Bioenergy Today

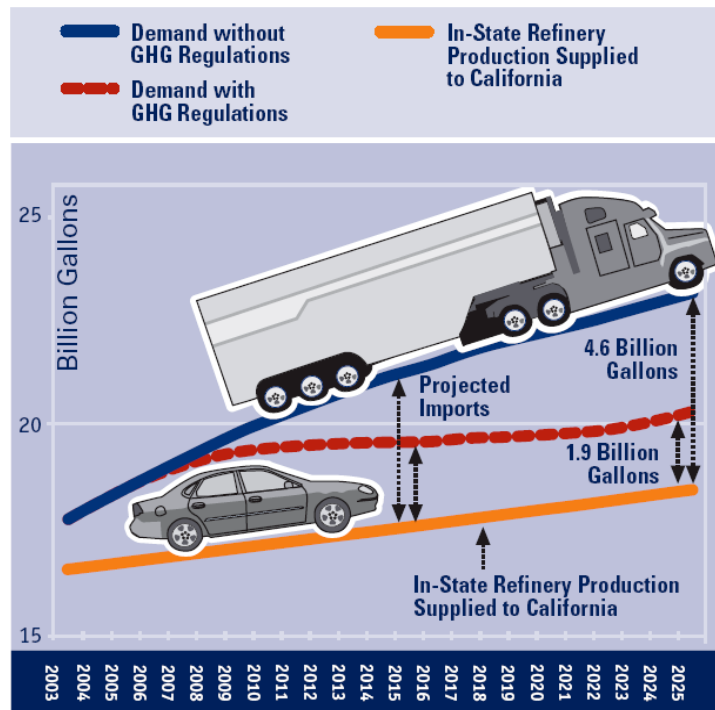
- Biomass Energy Facilities Provide ~1000 MW of Electricity Capacity through
 - Direct Combustion of Forestry, Ag and Urban Biomass
 - Landfill Gas to Energy (LFGTE) Facilities Convert Methane Rich Landfill Gas
 - Wastewater and Dairy Biogas Systems Process Biogas Into Useful Energy
- Biofuels - California consumers over 900 million gallons per year of ethanol and over 11 million gallons of biodiesel fuel.



Trends Petroleum and Non-Petroleum Consumption

The 2005 IEPR concluded that California needs to aggressively reduce its dependence on petroleum and introduce more non-petroleum options.

Projected Gasoline and Diesel Demand



Source: California Energy Commission, November 2005, 2005 Integrated Energy Policy Report

Demand for Gasoline and Diesel Fuel

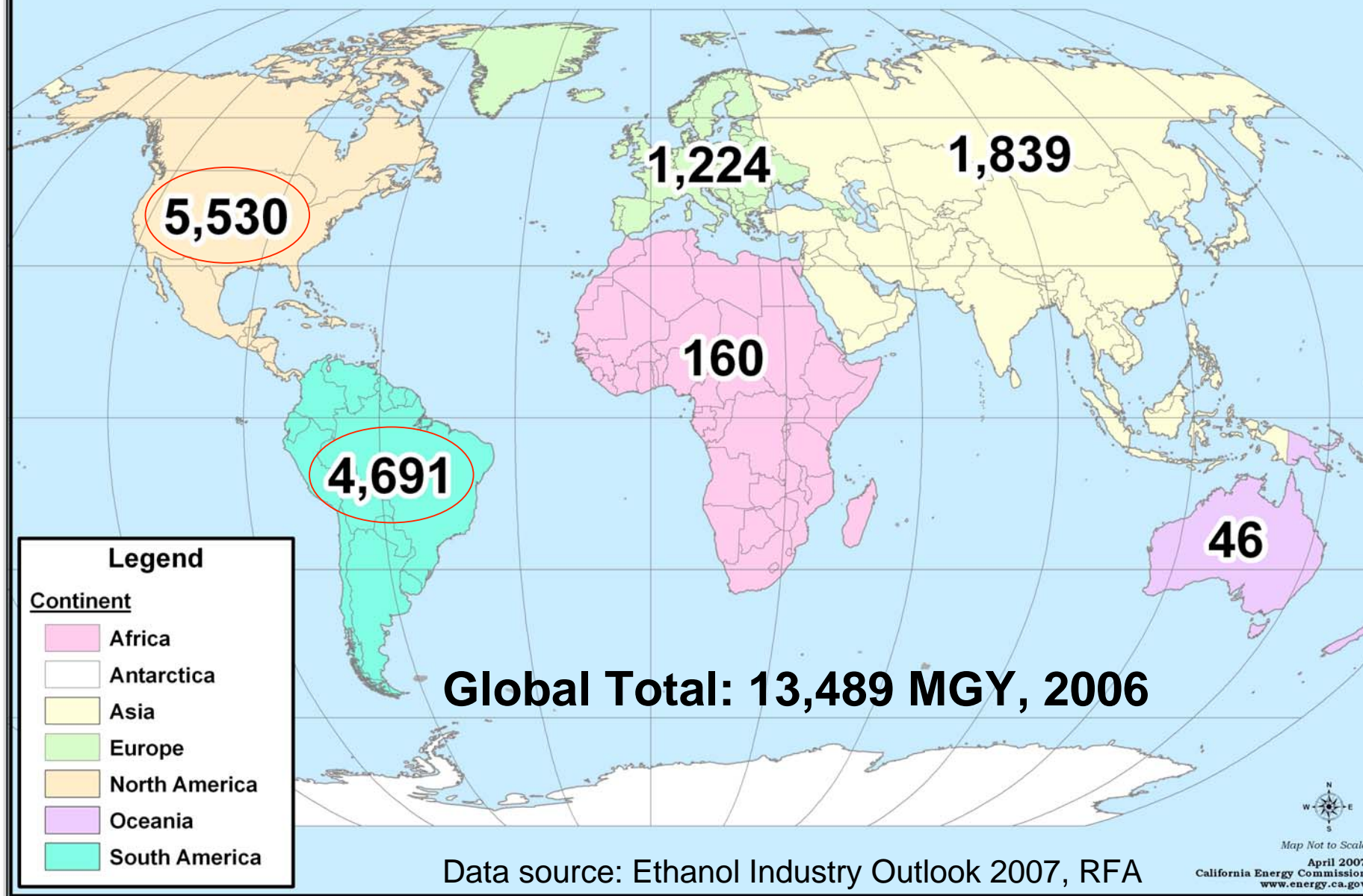
Demand continues, even in the face of record petroleum prices, for several reasons:

- Population growth and more on-road vehicles
- Low per-mile cost of gasoline for the past two decades
- Lack of alternatives to conventional gasoline and diesel fuels
- Consumer preference for larger, less fuel efficient vehicles
- Land use planning that places jobs and housing farther apart without transportation integration
- Lack of mass transit



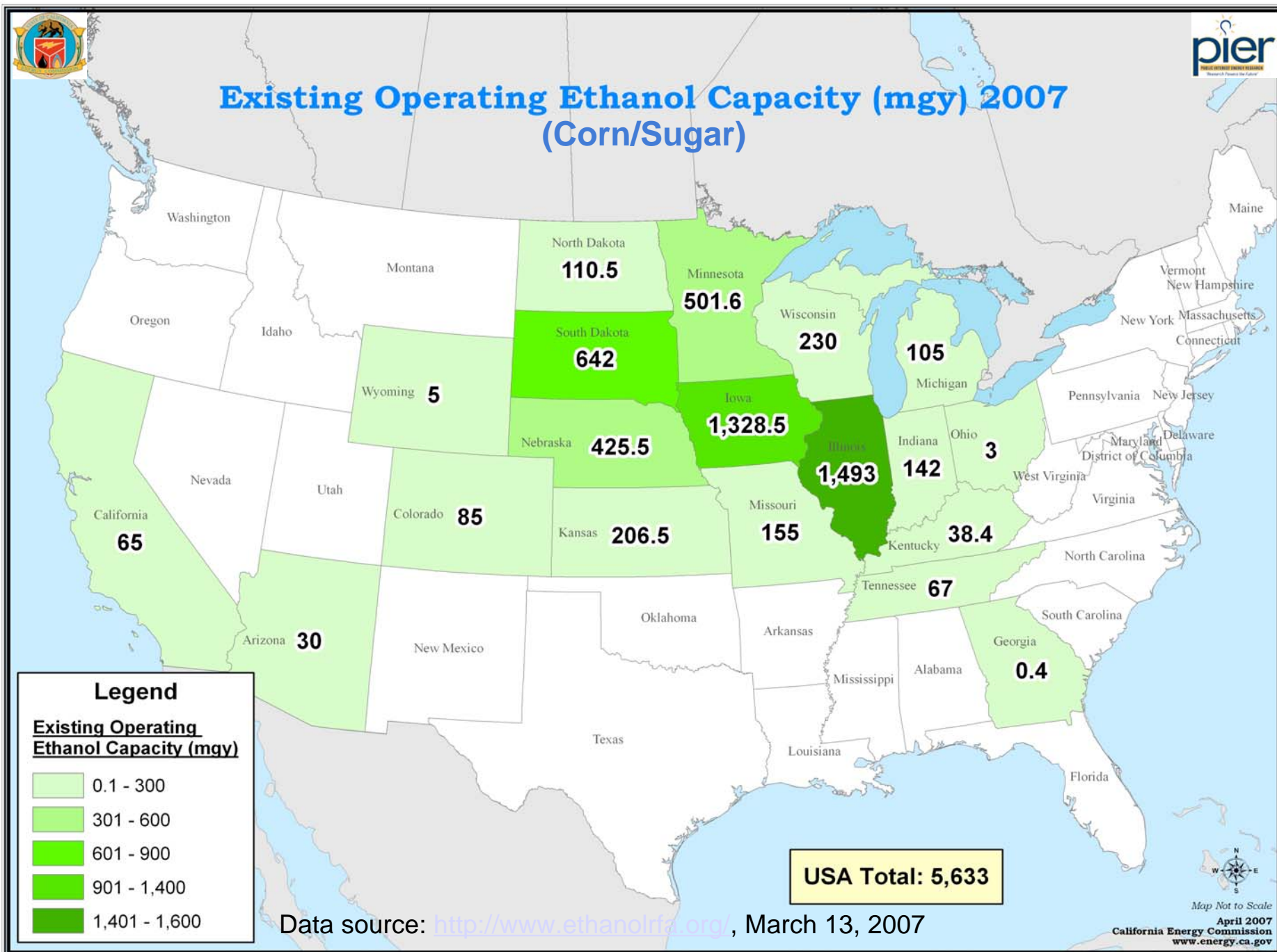


Global Ethanol Production (mgy) 2006 (Corn/Sugar)





Existing Operating Ethanol Capacity (mgy) 2007 (Corn/Sugar)



Data source: <http://www.ethanolrfa.org/>, March 13, 2007

USA Total: 5,633

Map Not to Scale

April 2007

California Energy Commission
www.energy.ca.gov



California Existing Ethanol Plants (Corn/Sugar)

CA Total: 68 MGY, 2007



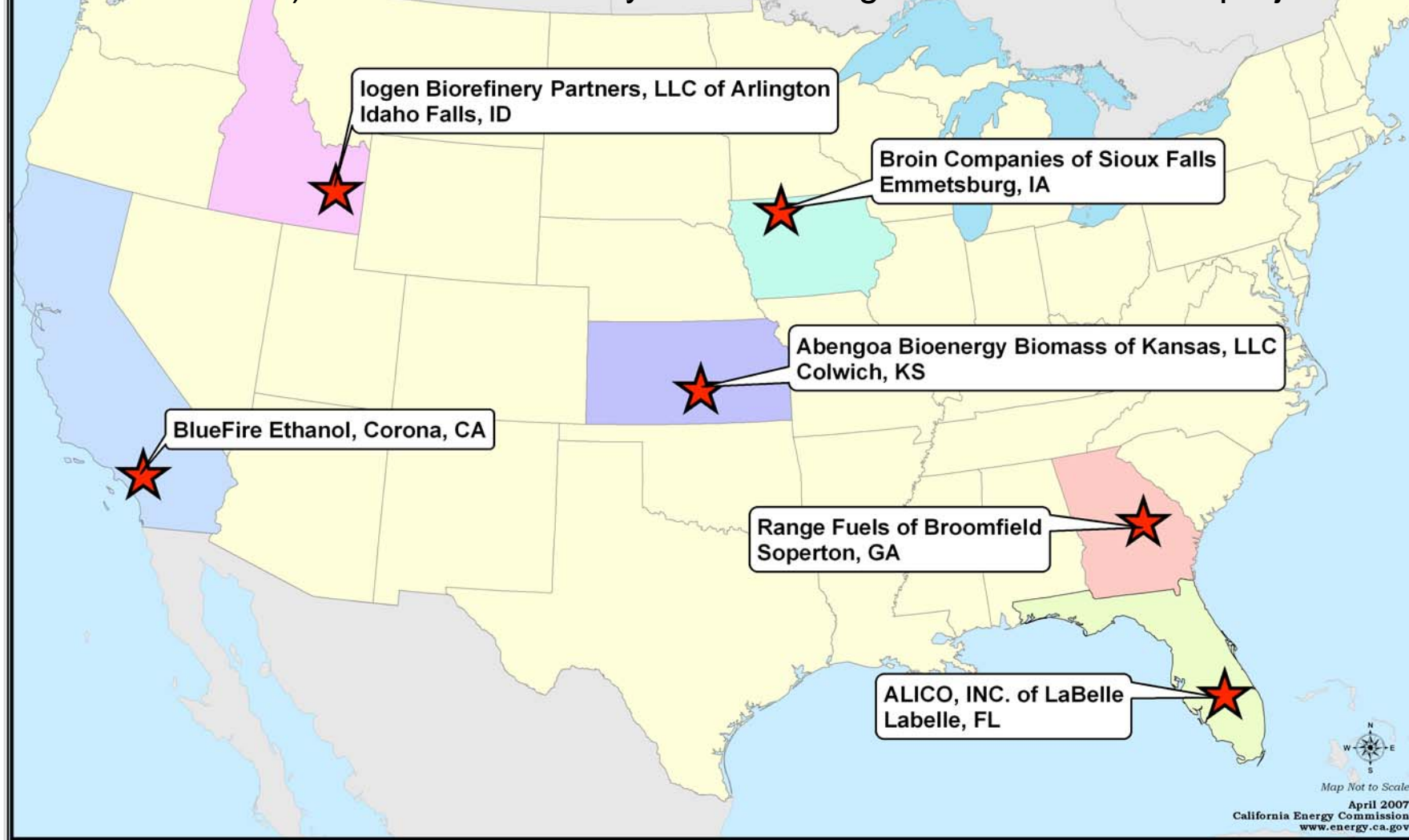
Data source: <http://www.ethanolrfa.org/>





Proposed Ethanol Facilities Awarded by DOE

(2/28/07) DOE announced a potential investment of up to \$385 million (40% of total cost) over the next four years in six Lignocellulose ethanol projects



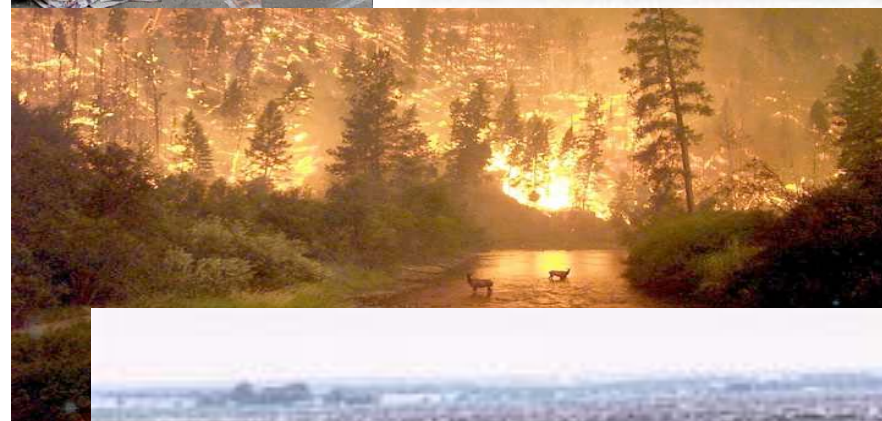
What are some challenges & opportunities for biomass in California?

- High cost
- Technology Gaps -
- Doesn't Receive Full Value for Delivered Benefits
- Fractured Industry
- Difficulty of securing long term contracts
- Arduous & complex permitting process
- Conflicting Policies and Regulations
- Lack of good public awareness
- Interconnection can be difficult
- Lack of agency coordination
- Lack of comprehensive biomass policy



Today Biomass Is Viewed as a Disposal Problem

- Reducing Landfill Capacity
 - About 40 million tons of biomass goes into landfills every year
- Contributing to Air Pollution and Fire Risk
 - Open field burning of crop residues emits more than 100,000 tons of air pollutants annually
 - Wildfires contribute over 1.1 million tons per year at a cost of >\$900 million/year
- Local Concerns
 - California's 1.67 million dairy cows generate odor and health concerns



Public Interest Energy Research (PIER) Program

- **IOU Ratepayer-funded program launched in 1997**
- **Addresses electricity, natural gas, and transportation sectors**
- **~\$80M annual budget; nearly \$400M in projects**
- **A leader in no/low-carbon technology and global climate change research programs**
 - Efficiency and Demand Response
 - Renewables
 - Clean Fossil Fuel Generation – Distributed Generation, Combined Heat & Power
 - Transportation
 - Energy Systems Research – Transmission and Distribution, Grid Interconnection
 - Environmental Impacts – Air, Water, Climate, Communities
- **Strong emphasis on collaborations**
 - Avoid duplication/builds on past work/ensures relevance
 - Regular coordination with IOUs via the Emerging Technology Coordinating Council to transition research to the marketplace
 - State Agency Partnerships (DGS/DOF, ARB, T-24,CDF,CAGR,CalEPA, IWMB)
 - Market Partnerships (California builders, Collaborative for High Performance Schools, California Commissioning Collaborative, major equipment manufacturers)
 - Use California Capabilities (Universities, National Laboratories, High Technology Companies)
 - Leverage/complement Federal Investments



PIER Goals Are Solution- Focused and Include Biomass

General Goal

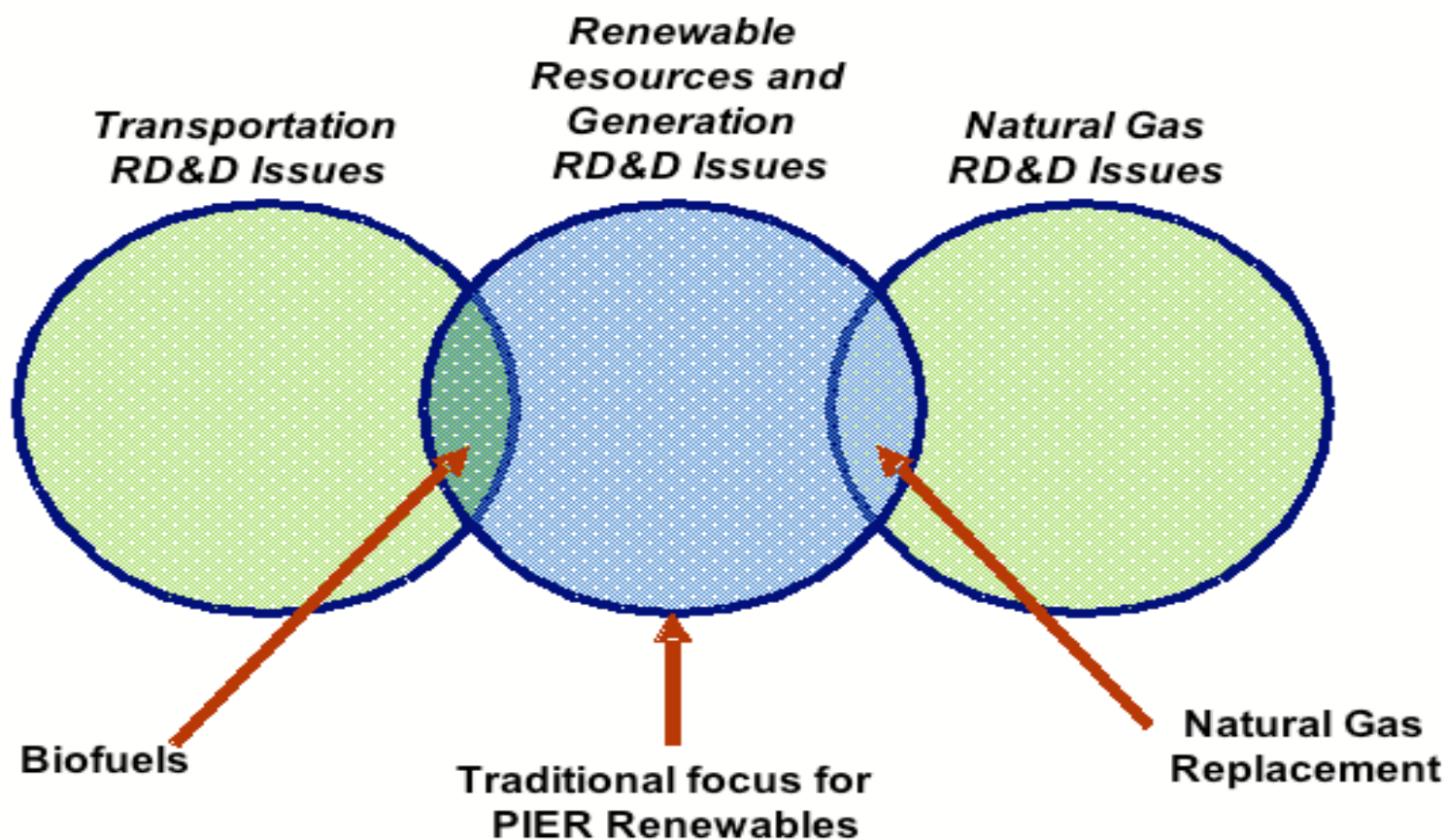
- “Develop and help bring to market, energy technologies that provide increased environmental benefits, greater system reliability, and lower system costs”

Specific Goals

- Develop and help bring to market
 - “Advanced transportation technologies that reduce air pollution and greenhouse gas emissions beyond applicable standards, and that benefit electricity and natural gas ratepayers.
 - “Increased energy efficiency in buildings, appliances, lighting, and other applications beyond applicable standards, and that benefit electric utility customers.
 - “Advanced electricity generation technologies that exceed applicable standards to increase reductions in greenhouse gas emissions from electricity generation, and that benefit electric utility customers.
 - “Advanced electricity technologies that reduce or eliminate consumption of water or other finite resources, increase use of renewable energy resources, or improve transmission or distribution of electricity generated from renewable energy resources.”



PIER Renewables Program RD&D Focus



Stages of Technology Development & PIER Renewables Role

Stages of Technology Development				
Research	Development	Demonstration	Commercialization	
			Market Entry	Market Penetration
<ul style="list-style-type: none"> • General assessment of resources and market needs • Assess general magnitude of economics • Concept and bench testing • Basic research and sciences (e.g., materials science) 	<ul style="list-style-type: none"> • Research on component technologies • Development and initial of product offering • Pilot testing 	<ul style="list-style-type: none"> • Integrate component technologies • Initial system prototype for debugging • Demonstrate basic functionality • Ongoing development to reduce costs or for other needed improvements • "Technology " (systems) demonstrations • "Commercial " demonstration • Standards creation • Testing and certification 	<ul style="list-style-type: none"> • Initial orders • Early movers or niche segments • Product reputation is initially established • Business concept implemented • Market support usually needed to address high production cost 	<ul style="list-style-type: none"> • Follow - up orders based on need and product reputation • Broad(er) market penetration • Infrastructure developed • Full - scale manufacturing

PIER Renewables Technology Research

PIER Renewables co -funds research for renewable technologies from applied research to the demonstration stage

PIER Renewables Policy and Adoption Support Research

PIER Renewables funds research to support policy development, ad option and integration for renewables energy technologies in all stages of development



Biomass Technology Gaps

- Electricity Generation Gaps
 - Costs still need to come down to more competitive levels
 - Air emission profiles (esp. NO_x) need to meet or exceed regulations (e.g., CARB 2007 guidelines)
 - At utility-scale sizes, need development of super clean, super-efficient systems with high degree of responsiveness
 - At DG levels - small modular-scale, need to develop a track record
- Transportation Technology Gaps
 - Lack of commercial cellulosic to ethanol technologies
 - ◆ Development and demonstration of cellulosic facilities
 - ◆ Development of track record on performance and cost
 - ◆ Development of infrastructure for production & delivery of fuel
 - Lack of track record for biodiesel



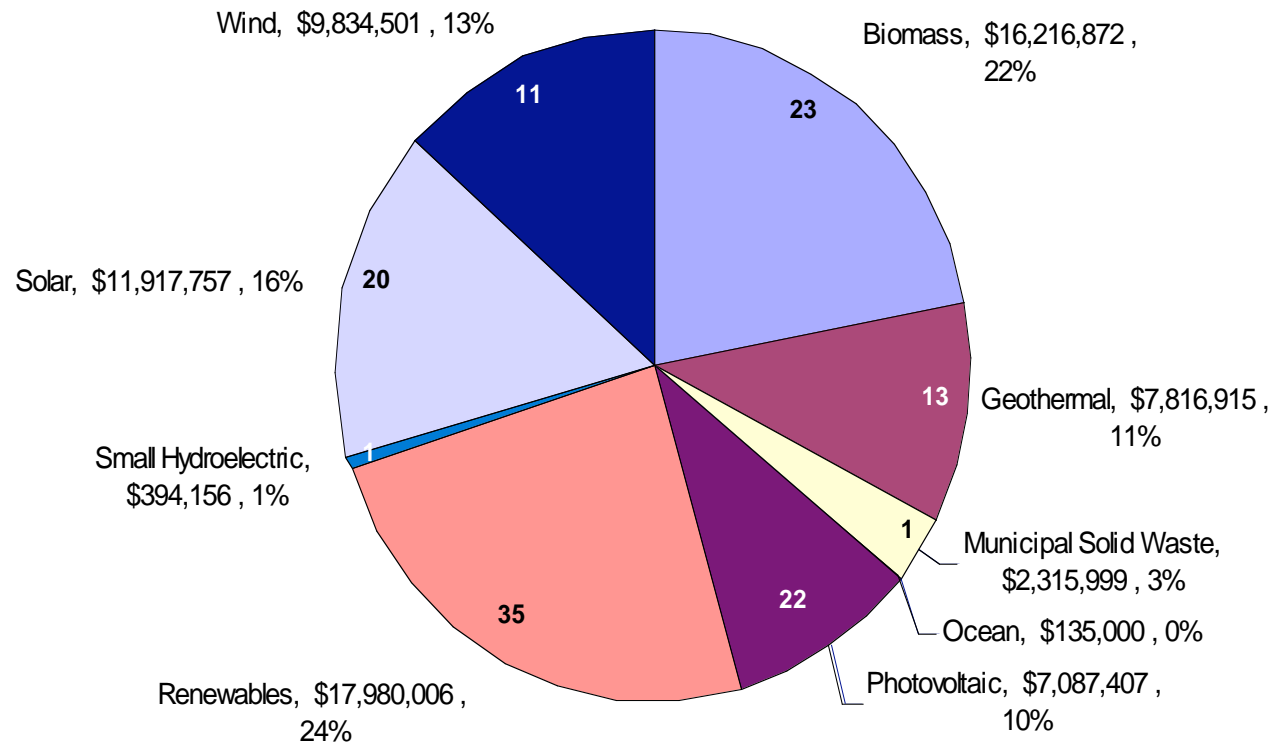
PIER-Biomass R&D Activities

- Technology Development
 - Direct Combustion/Co-firing Systems
 - Biogas
 - Thermal Gasification/Pyrolysis
 - Biofuels
- Analysis and Planning
 - California Biomass Collaborative
 - ◆ Biomass Roadmap for biomass development
 - ◆ Biomass Resource Assessments
 - ◆ Biomass Performance Reporting System
 - Strategic Value Analysis
 - ◆ Linking cost competitive biomass resources to electricity system needs while addressing public benefits
- Natural Gas Replacements by Biomass
 - Implement Natural Gas Program Plan
 - PIER Transportation



PIER Portfolio Summary

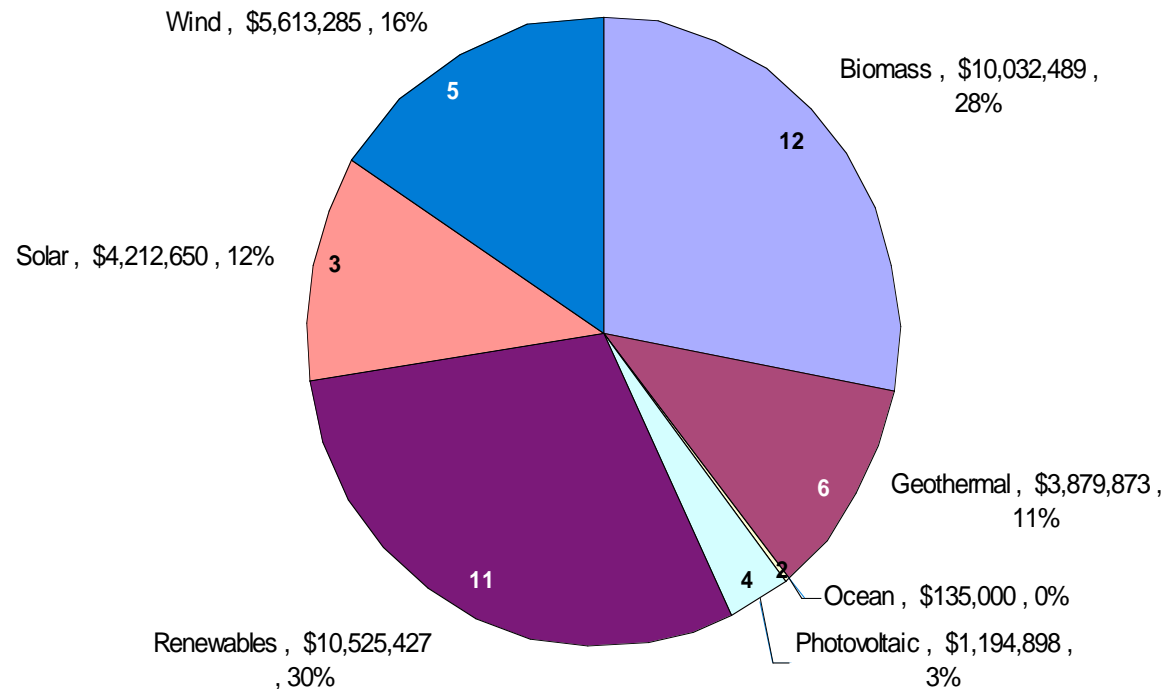
Renewables Projects - Active and Closed
128 Projects, \$73.7 Million



PIER Portfolio Summary

Renewables Projects - Active

43 Projects, \$35.6 Million



Resource Assessments



California Energy

Agriculture

Forestry

Urban

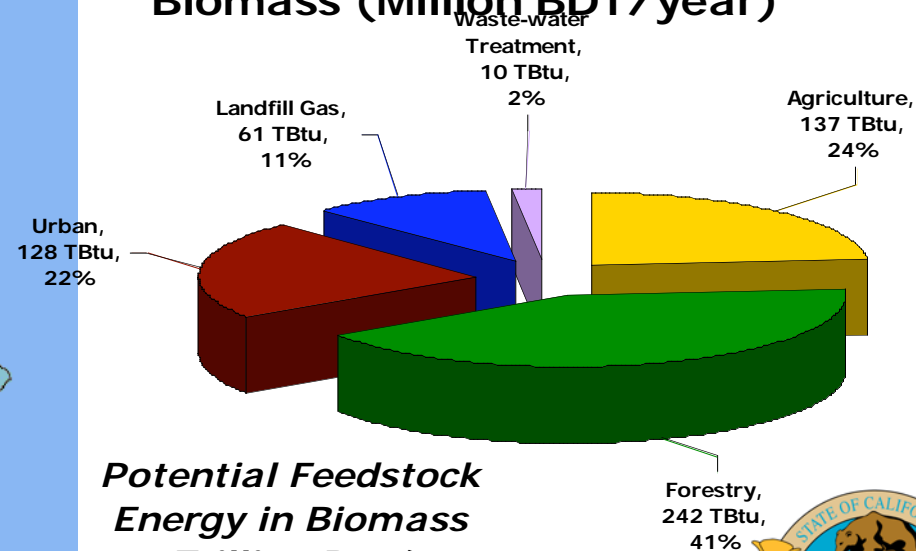
Total

■ Potential Feedstock
■ Gross Biomass

+ 137 BCF/year landfill and digester gas

0 20 40 60 80 100

Biomass (Million BDT/year)



**Potential Feedstock
Energy in Biomass
507 Trillion Btu/year**



California Biomass Resources

California Biomass Resources



0 20 40 60 80 100 Miles

Data source: CALVEG 2002 Version 2

Total Categorical Bioenergy Potentials in California

Category	Biomass (Million BDT/year)	Energy in Product (Trillion Btu/year)	Total Capacity
Electricity	32	118 (35 TWh)	4,650 MWe
CHP Heat		230	9,050 MWt
Heat	32	350	11,700 MWt
Biochemical Biofuel	32	188	1.5 BGY gasoline equivalent
Thermochemical Biofuel	27*	250	1.7 BGY diesel equivalent
Biomethane	5 + Landfill gas and WWTP	106	106 BCF/y methane
Hydrogen (bio + thermal)	32	305	2.5 Million tons/y

* Tonnage for thermochemical biofuel assumed to be constrained by moisture content

Current California consumption:

16 billion gallons gasoline + 4 billion gallons diesel = 2,500 Trillion Btu/year direct energy content

300 TWh/y electrical energy = 1,024 Trillion Btu/year direct energy



PARTNERSHIPS – RESOURCES – KNOWLEDGE BASE

Mission

- To enhance the sustainable management and development of biomass in California
- Provide a forum for industry, government, academic, and environmental community interactions

California Biomass Collaborative



Projects:

- Supporting and providing expertise to enhance biomass R&D program mission and strategy (short & long term)
- Established focal center - Statewide biomass coordinating group
- Updated biomass resource assessments
- Building Biomass Facilities Reporting System
- Power generation assessments or Technology assessments
- White papers, newsletters
- Annual Forums
- Cost calculators
- Supported IEPR process
- Coordination with State Interagency Working Group
- Roadmap for biomass development
- Biomass Roadmap – Public workshop on Nov 16, 2006



California Biomass Roadmap

Vision: Sustainable biomass resources energize a healthy and prosperous California through the environmentally beneficial production and use of renewable energy, biofuels, and bioproducts.

Priority Areas

- Resource access and feedstock markets and supply
- Market expansion, access, and technology deployment
- **Research, development, and demonstration**
- Education, training, and outreach
- Policy, regulations, and statutes

RD&D

- 📁 Resource Base, Sustainability and Access
- 📖 Bioscience/Biotechnology
- 📖 Biomass Conversion
- 📖 Feedstock Processing
- 📖 Systems Analysis
- 🕒 Knowledge/Information Resources

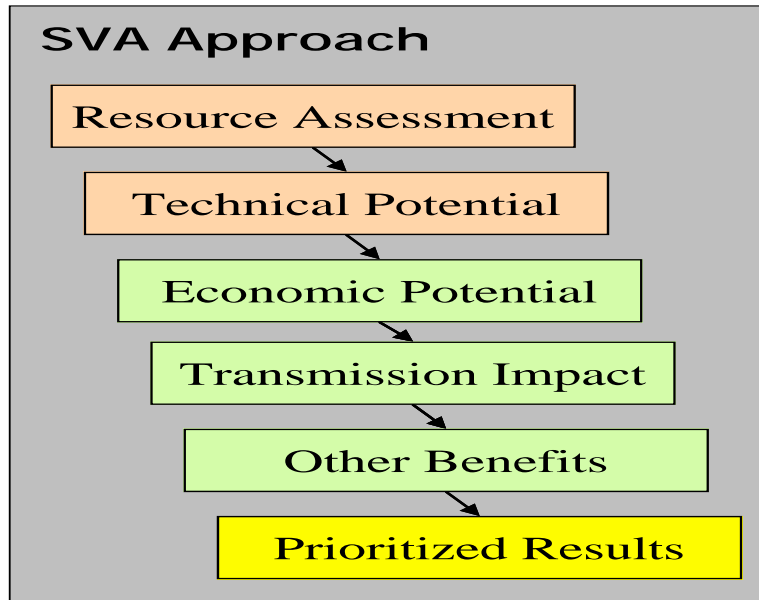


PIER Biomass R&D Projects

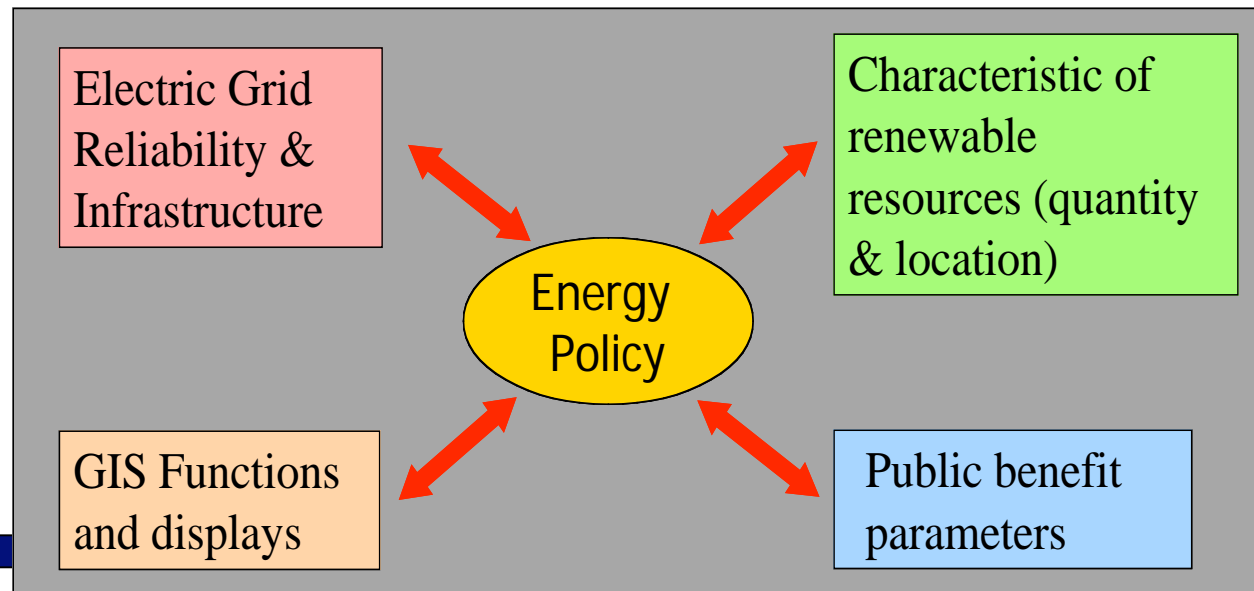


Biomass SVA Methodology

SVA Approach



- Biomass Resource Assessment – evaluate gross & technical potentials
- Characterize cost and performance biomass energy development
- Evaluate economic potential of biomass resources using GIS
- Power flow simulations that provide solutions that can defer transmission upgrades & reduce congestion
- Evaluate economics of biomass energy conversion technologies
- Levelized cost of electricity (LCOE)
- Evaluate MW solutions that will meet RPS targets by 2010 and 2017



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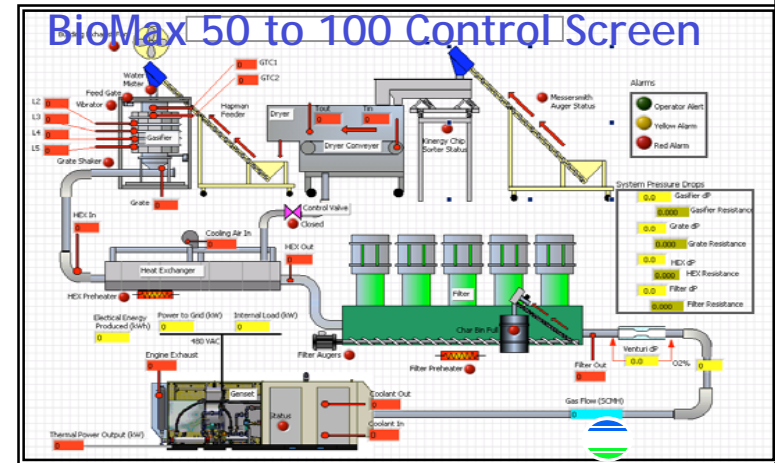
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50 kW Small Modular Biopower System

- Contractor: Community Power Corporation
- Goals:
 - Design, develop and demonstrate a 50 kW modular gasification system for grid interconnection, and combined heat and power using forest residue.
 - Improve cost competitiveness of the biomass energy conversion technologies and reduce environmental risks and costs of California's electricity.
- Project Site
 - Harwood products, Branscomb, CA
- Status:
 - Completed the design and fabrication of the SMB components
 - Completed Shop testing at CPC
 - $\text{NO}_x = 0.39 \text{ lb/MWh}$ using catalytic converters
 - $\text{CO} = 4.47 \text{ lb/MWh}$
 - Field testing expected to start in July 2007

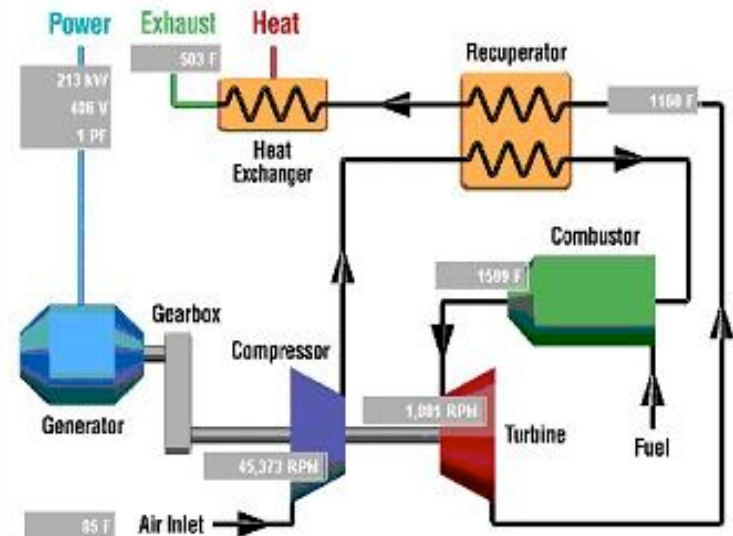


250 kW Microturbine Using Landfill Gas

- **Goals:**
 - Provide a low-cost high efficiency distributed power generation engine that runs on landfill gas
 - Efficiently use landfill gas to generate electricity (removing greenhouse gas from environment) while limiting emissions to very low levels
- **Project Team:**
 - SCS Engineers, Ingersoll-Rand & City of Burbank
- **Location:**
 - City of Burbank – Landfill No. 3
- **Results:**
 - Modified natural gas microturbine to accept landfill gas
 - Installed microturbine and balance of plant
 - Performed a seven-day reliability test
 - Completed 12-month demonstration test since June 23, 2005
 - Tested over 10,000 hours of operation with NO_x emissions of 0.265 lb/MWh and availability higher than 90%



250 kW Microturbine Engine Cycle

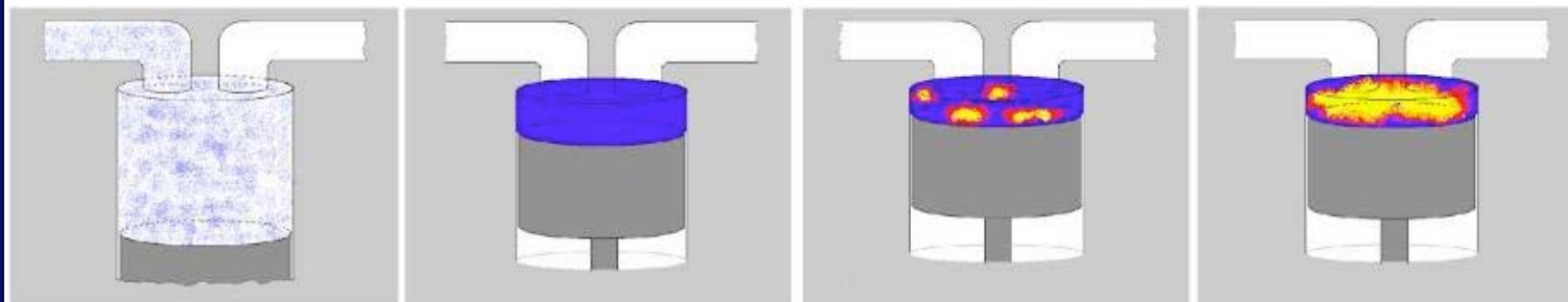
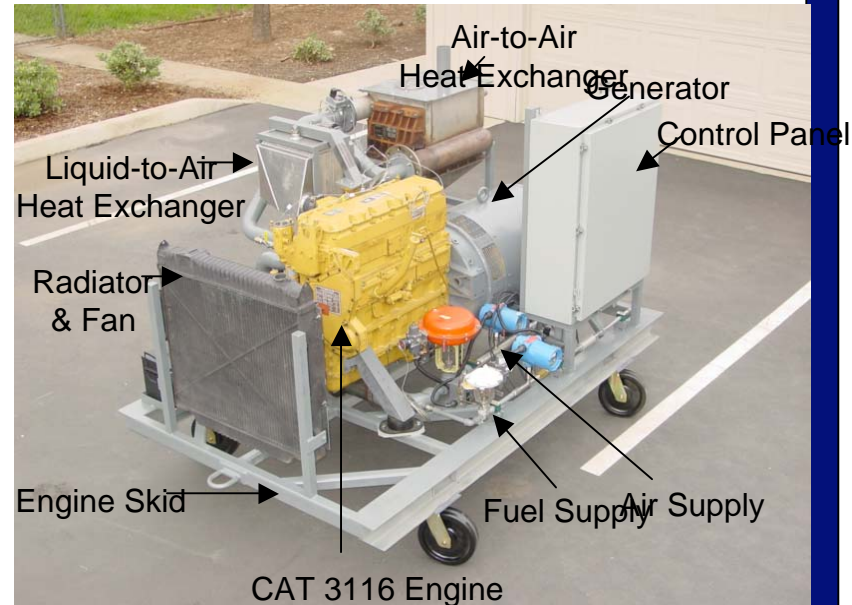


HCCI using Landfill Gas

Makel's HCCI: (*homogeneous charge compression ignition*) Low NOx Generator – Butte County Landfill

Contractor: Makel Engineering

The HCCI Combustion Process



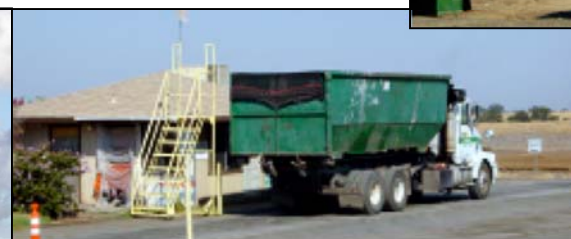
Source: Per Amneus, Lund Institute of Technology

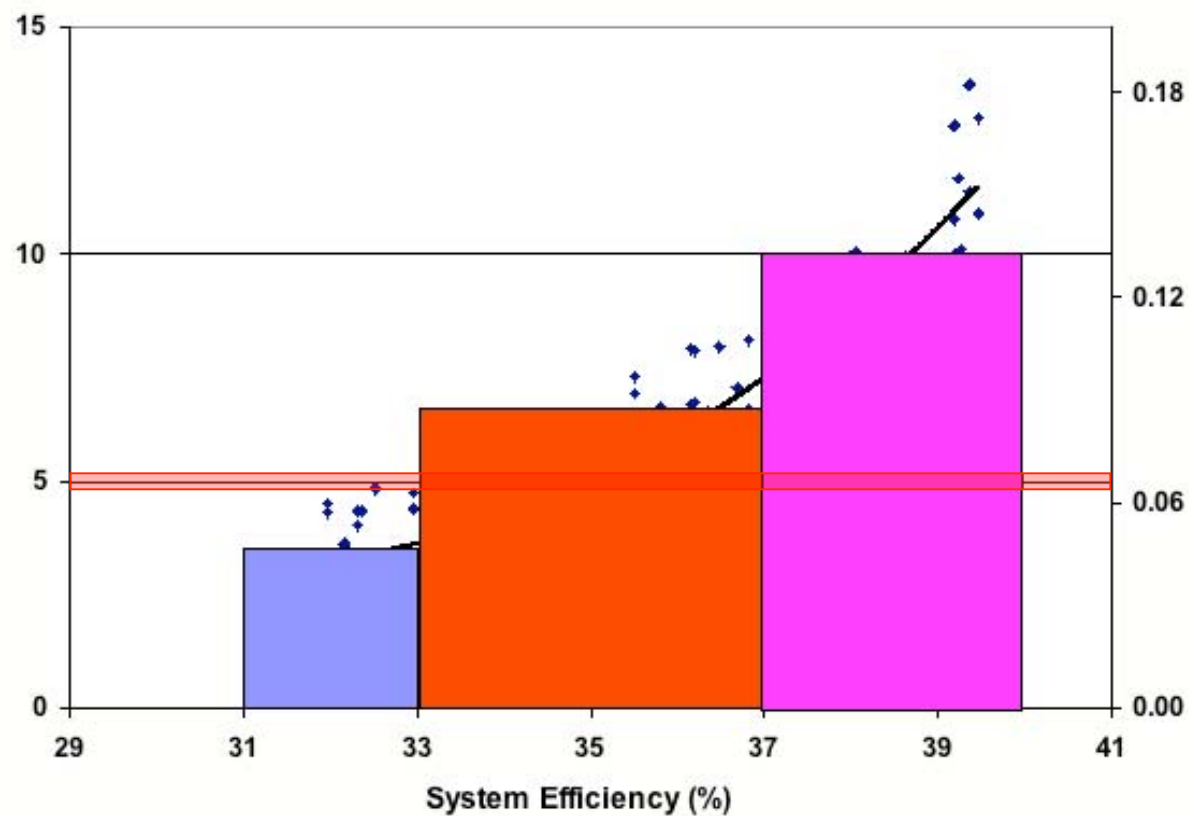
- Homogeneous mixture formed early in cycle
- Mixture compressed to high temperature and pressure
- Fuel/air chemistry results in ignition near top dead center
- Very rapid combustion event follows ignition



Makel - Project Performance Goals

- System efficiency of 35% operating on LFG
- System stability of less than 10% efficiency variation
- System durability of greater than 10,000 hours between overhauls
- System NOx emission of approximately 5 ppm (0.07 lb/MW-hr)
- System cost of less than 750 \$/kW
- System electricity generation of less than 0.05 \$/kWh



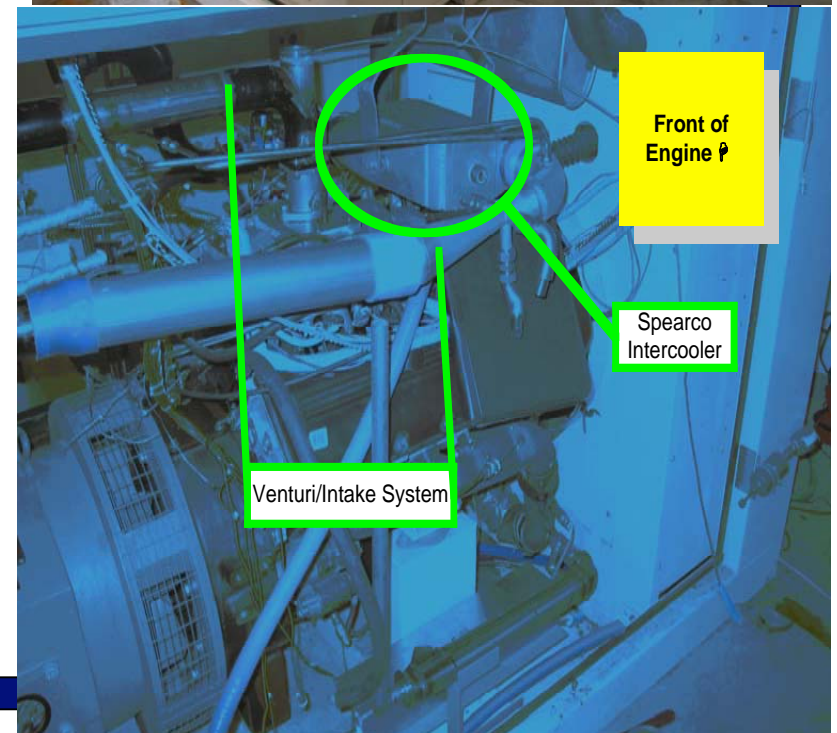


EFFICIENCY (%)	NO _x (ppm)-(lb/MW-hr)*
37-39	8-14 (.10-.17)
33-37	4-8 (.05-.10)
31-33	2-4 (.03-.05)



Application of Hydrogen Assisted Lean Operation to Biogas-Fueled Reciprocating Engines (Bio-HALO)

- Contractor: **TIAX LLC**
- Goals:
 - **Demonstrate an innovative new engine system**
 - **With NOx emissions at 0.032 g/bhp-hr**
 - **Successful demonstration of a landfill gas autothermal reformer with 70% efficiency**
 - **Costs < \$1000/kW**
- Project Site:
 - **TBD**
- Status:
 - **Engine fabricated and tested on simulated landfill gas & synthetic reformat**



BioHALO- NOx results Using simulated landfill gas & synthetic reformat

IMEP (bar)	IMEP COV (%)	NOx (Corrected to 15 % O2) [ppm]	NOx (g/bhp hr, 15% O2)	H2 LHV/CH4 LHV	NOx (lb/MW hr), 15 % O2
5.4	8.1	5	0.035	13.5%	0.10
6.9	11.0	7	0.044	11.4%	0.13
6.6	8.7	10	0.071	7.5%	0.21
6.8	12.4	9	0.078	14.7%	0.23
N/A	N/A	4	0.043	14.2%	0.13
6.1	8.7	8	0.044	10.7%	0.13
5.9	3.7	7	0.047	14.7%	0.14
6.6	8.7	10	0.071	7.5%	0.21



Yolo County's BioReactor

- **Contractor: SMUD/Yolo Co.**
- **Goals:**
 - ❑ **Successful demonstration of bioreactor concept at full-scale**
 - ❑ **Accelerate decomposition of waste by 2/3rds normal timeframe**
 - ❑ **Document economic viability**
- **Project Site:**
 - ❑ **Yolo County landfill**
- **Status:**
 - ❑ Collected data shows that landfill bioreactor can accelerate organic portion of the solid wastes decomposition and methane recovery rates 4 to 7-fold as compared with conventional operation
 - ❑ The project has documented technical data needed to establish environmental and renewable energy benefits to help facilitate regulatory acceptance



Valley Fig Growers' Anaerobic Digester for Food Wastes

- **Contractor:** Valley Fig Growers
- **Goals:**
 - ❑ *Demonstrate successful use of ADT for pre-treatment of food processing wastewater*
 - ❑ *Save ~ \$100,000/yr in waste discharge costs paid by VFG*
 - ❑ *Demonstrate CHP application of microturbine at site*
- **Project Site:**
 - ❑ **Valley Fig (Fresno)**
- **Status:**
 - ❑ Installed a covered lagoon that reduces BOD and SS by over 90% and generates 25 to 65 kW of electricity for use on-site
 - ❑ Save an annual cost of \$100,000 that VFG currently pays to the Fresno city
 - ❑ Reduce greenhouse gas (methane) emission at 148 tons per year
- **Awards Received**
 - ❑ A Certificate from the City of Fresno in recognition of the merits of biogas digester installed
 - ❑ An Honor Award in CELSOC's (Consulting Engineers and Land Surveyors of California) 2007 Engineering Excellence Award Competition



Inland Empire Utility Agency (IEUA) Centralized Digester

- **Contractor:** IEUA
- **Project Location:** Chino, CA
- **Goals:**
 - Demonstrate a cost-effective European centralized digester for codigestion of dairy manure and food wastes
 - Generate 1.5 MW of electricity to be used on site
- **Status:**
 - Under Construction
 - Starting up in April 2007

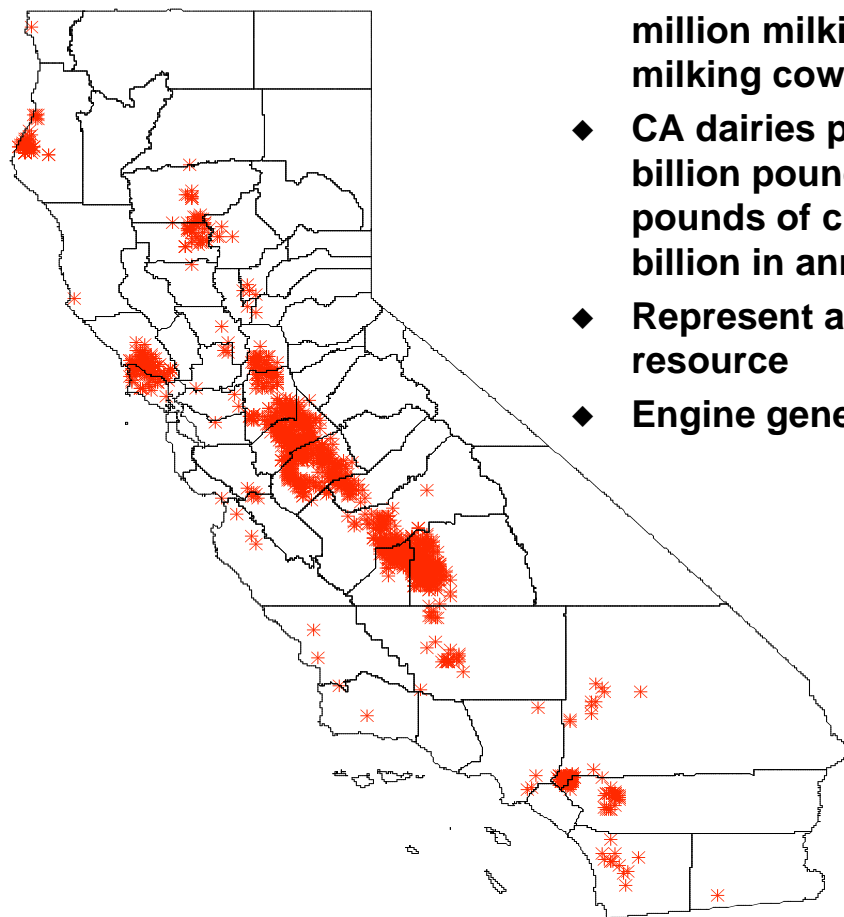


UC Davis' High Solids Digester

- **Contractor: UC Davis & OnSite Power**
- **Goals:**
 - Scale up, test and demonstrate APS high solids digester
 - ◆ 3 tpd size at UC Davis
 - ◆ 25 tpd at Norcal Waste
 - Methane generation rate $> 6 \text{ ft}^3 \text{ CH}_4/\text{lb of VS}$
 - Achieve CARB 2007 NOx goals
- **Project Site:**
 - UC Davis & City of Industry
- **Status:**
 - Digester construction is complete
 - Public Opening on October 24, 2006
 - Pilot testing will start in April 2007



Distribution of Dairies in California



- ◆ California is home to about 1.67 million milking cows – 18% of US milking cows
- ◆ CA dairies produce more than 27 billion pounds of milk, 1.25 billion pounds of cheese and generate \$3 billion in annual sales
- ◆ Represent a significant bioenergy resource
- ◆ Engine generators at 10 CA dairies



Dairy Power Production Program

Biogas Digesters Installed at 10 Dairies in CA & more...



Castelanelli



Cottonwood



Hilarides



Straus



Laurenco



Meadowbrook



Van Ommering



Eden-Vale



Koetsier



IEUA

- 10 systems awarded (8 Buydown and 2 Incentive) ~ generating **2.5 MW** total
- 5 Covered lagoons and 5 plug flow digesters
- 6 new systems in which 4 are installed by RCM and 1 installed by Sharp Energy and 1 installed by Williams Engineering
- 4 refurbished systems
- Lactating cows range from 245 to 7931
- Dairy manure or mixture of dairy manure with cheese wastewater, creamery wastewater, and food processing wastewater



California - Biofuels RD&D Grant Solicitation

- PIER Funding Available: \$3 million
- This is a targeted grant solicitation with the intent of accelerating RD&D of biofuel energy conversion technologies and refineries using lignocellulosic biomass such as agricultural and forest residues, urban waste, and food waste, beverages, waste grease, and purpose-grown crops.
- Released date: Oct 31, 2006
- Due date: Jan 4, 2007, 19 proposals received
- Award date: NOPA Released on March 14, 2007 for 3 projects



California - Biofuels RD&D Projects

- Metcalf & Eddy and San Francisco Public Utility Commission: Brown Grease Recovery and Biofuel Production Demonstration
- Renewable Energy Institute International: Demonstration of an Integrated Biofuels and Energy Production System
- Bluefire Ethanol: California Lignocellulosic Biorefinery Project



Concluding Remarks

- **California has abundant biomass resources**
- **The PIER Program & Bioenergy Interagency Working Group and its member agencies are committed on making CA biomass resources part of the State's energy future**
 - **Planning and implementation of policy drivers**
 - **Resolving potential barriers to renewables development**
 - **Developing the next generation of biomass to energy conversion systems that will help make California's electricity and transportation fuels more cost competitive, reliable, safer and cleaner**
 - **Working closely and cooperatively with key stakeholders to meet California's special needs and take advantage of unique opportunities**
- **Develop Clean and Affordable Biomass Systems**
 - **Biogas & Biofuel systems that meet or exceed air & water quality standards**
 - **Small modular biomass systems that can help address electricity needs while simultaneously helping reduce wildfires and landfill capacity problems**
 - **Super clean, super-efficient biomass energy conversion systems with high strategic value to CA**



Thank You

Additional information can be found at:

The Energy Commission's web site has extensive information on the ongoing bioenergy work in California at:

http://www.energy.ca.gov/bioenergy_action_plan

http://www.energy.ca.gov/2005_energypolicy/

